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Mark Scheme (Results)
Summer 2008

GCE

GCE Salters Horners Physics (6755/02)

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Mark scheme notes

Underlying principle

The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. It is not a set of model answers.

For example:

(iii) Horizontal force of hinge on table top

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] [Some examples of direction: acting from right (to left) / to the left / West / opposite direction to horizontal. May show direction by arrow. Do not accept a minus sign in front of number as direction.]	✓	**1**

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

1. Mark scheme format

1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the ms has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'

1.2 Bold lower case will be used for emphasis.

1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".

1.4 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. Unit error penalties

2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally cause the final calculation mark to be lost.

2.2 Incorrect use of case e.g. 'Watt' or 'w' will **not** be penalised.

2.3 There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given.

2.4 The same missing or incorrect unit will not be penalised more than once within one question but may be penalised again in another question.

2.5 Occasionally, it may be decided not to penalise a missing or incorrect unit e.g. the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.

2.6 The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

3. Significant figures

3.1 Use of an inappropriate number of significant figures in the theory papers will normally only be penalised in 'show that' questions where use of too few significant figures has resulted in the candidate not demonstrating the validity of the given answer.

3.2 Use of an inappropriate number of significant figures will normally be penalised in the practical examinations or coursework.

3.3 Using g = 10 m s^{-2} will **not** be penalised.

4. Calculations

4.1 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.

4.2 If a 'show that' question is worth 2 marks then both marks will be available for a reverse working; if it is worth 3 marks then only 2 will be available.

4.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

4.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.

4.5 The mark scheme will show a correctly worked answer for illustration only.

4.6 Example of mark scheme for a calculation:

'Show that' calculation of weight

Use of L × W × H	✓	
Substitution into density equation with a volume and density	✓	
Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] [Allow 50.4(N) for answer if 10 N/kg used for g.] [If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark] [Bald answer scores 0, reverse calculation 2/3]	✓	**3**

Example of answer:

$80 \text{ cm} \times 50 \text{ cm} \times 1.8 \text{ cm} = 7200 \text{ cm}^3$

$7200 \text{ cm}^3 \times 0.70 \text{ g cm}^{-3} = 5040 \text{ g}$

$5040 \times 10^{-3} \text{ kg} \times 9.81 \text{ N/kg}$

$= 49.4 \text{ N}$

5. Quality of Written Communication

5.1 Indicated by QoWC in mark scheme, placed as first mark.

5.2 Usually it is part of a max mark.

5.3 **In SHAP marks for this are allocated in coursework only but this does not negate the need for candidates to express themselves clearly, using appropriate physics terms. Likewise in the Edexcel A papers.**

6. Graphs

6.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

6.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

6.3 A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis and is not an awkward scale e.g. multiples of 3, 7 etc.

6.4 Points should be plotted to within 1 mm.

- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

6.5 For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Question Number	Answer	Mark
1 (a)	Name of effect • Resonance • Idea that step frequency = natural frequency of bridge	**2x1**
(b) i	Why oscillations are forced • E.g. amplitude is increasing OR oscillations are driven by the wind	**1x1**
(b) ii	Calculation of maximum acceleration • Use of $\omega = 2\pi / T$ to obtain value for ω • Correct answer for acceleration [14 m s^{-2}] Example of calculation: $\omega = 2\pi / T = 2\pi /(60\text{ s} / 38) = 4.0\text{ s}^{-1}$ $a_{max} = \omega^2 A = (4.0\text{ s}^{-1})^2 \times 0.90\text{ m} = 14\text{ m s}^{-2}$	**2x1**
(b) iii	Show that car loses contact • Required a_{max} is greater than g • So, at a position (of 0.61 m) above the equilibrium position, vehicle loses contact with the road Example of calculation: $x = g/\omega^2 = 9.81\text{ ms}^{-2}/(4\text{ s}^{-1})^2 = 0.61\ m$	**2x1**
		7

Question Number	Answer	Mark
2 (a)	Name of reaction • (Nuclear) fusion	**1x1**
(b) i	How to determine distance of star • Explanation using $F = L / 4\pi d^2$ (Use known luminosity with measured flux at Earth to determine d)	**1x1**
(b) ii	How to determine velocity of star • Mention of Doppler Effect OR red shift • Identify (pattern of) lines and **compare with** lab frequency • $\Delta f \propto$ (relative) v OR the greater the velocity of the star (relative to Earth), the greater the change in frequency/wavelength observed	**Max 2**
(c) i	Line of best fit • Insertion of line of best fit, through origin ± 1 square, with approx. the same number of points each side of line • Idea that the greater the distance to the galaxy, the greater its velocity (relative to Earth)	**2x1**
(c) ii	Use of gradient to calculate age of universe • Use of $v = H_o d$ to argue that H_o is the gradient of the graph • Correct answer for age of universe [4.6×10^{17} s, accept 4.0×10^{17} s → 5.2×10^{17} s] Example of calculation: 1/gradient = 120×10^6 pc $\times$ 3.09×10^{16} m pc^{-1} / $8{,}000 \times 10^3$ m s^{-1} = 4.6×10^{17} s	**2x1**
		8

Question Number	Answer	Mark
3 (a) i	Meaning of symbols • m = mass of a gas molecule • $\langle c^2 \rangle$ = mean square speed of gas molecule • T = absolute temperature [accept kelvin temperature]	**3x1**
(a) ii	Physical quantity represented • (mean) kinetic energy (of a gas molecule)	**1x1**
(a) iii	Calculation of velocity • Use of $\frac{1}{2} m \langle c^2 \rangle = 3/2\ k\ T$ with T = 223 K • Correct answer for velocity [410 ms^{-1}] Example of calculation: $c = \sqrt{(3 \times 1.38 \times 10^{-23}\ J\ K^{-1} \times 223\ K\ /\ 5.4 \times 10^{-26}\ kg)} = 413\ m\ s^{-1}$	**2x1**
(b) i	Obtain expression for escape velocity • Idea that total energy must be zero for molecule just to escape • So, $\frac{1}{2} m v_{esc}^2 - GMm/r = 0$, leading to required equation	**2x1**
(b) ii	Show that escape velocity > 10 kms^{-1} • *Use of* $v_{esc} = \sqrt{(2GM/r)}$ with $r = (6.37 + 0.10) \times 10^6$ m • Correct answer for escape velocity [11.1 kms^{-1}, at least 2 sig. figs. required] Example of calculation: $v_{esc} = \sqrt{(2GM/r)}$ $v_{esc} = \sqrt{(2 \times 6.67 \times 10^{-11}\ N\ m^2\ kg^{-2} \times 5.98 \times 10^{24}\ kg\ /(6.37+0.10) \times 10^6\ m)}$ $= 1.11 \times 10^4\ (m\ s^{-1})$ $= 11.1\ (km\ s^{-1})$	**2x1**
(b) iii	Use of graph to explain whether molecules are likely to escape • Idea that only a tiny fraction of molecules have a very high velocity • Any quantitative attempt to compare the r.m.s. velocity with the escape velocity leading to the conclusion that molecules are not likely to escape. e.g. 410 is much less than 11,000	**2x1**
		12

Question Number	Answer	Mark
4 (a)	<u>Change in nuclear composition</u> • Nucleus has one less neutron OR nucleus has one more proton)	**1x1**
(b) i	<u>Calculation of age of skull</u> • Use of $\lambda = \ln 2 / t_{½}$ to obtain value for λ • Use of $N = N_o e^{-\lambda t}$ • Correct answer for age of skull [1.2×10^4 y; 3.83×10^{11} s] Example of calculation: $\lambda = \ln 2 / t_{½} = \ln 2 / 5730$ y = 1.2×10^{-4} y^{-1} [3.84×10^{-12} s^{-1}] $\ln(N/N_o) = -\lambda t$ $\ln(2.3 \times 10^{-11} / 1.0 \times 10^{-10}) = -(1.2 \times 10^{-4}\ y^{-1})t$ $t = 1.2 \times 10^4$ y *Alternative mark scheme* • Use of half life rule • Correct answer for number of half lives [2.12] • Correct answer for age of skull [1.2×10^4 y] Example of calculation: $N / N_o = (0.5)^n$ $(2.3 \times 10^{-11}) / (1 \times 10^{-10}) = (0.5)^n$ $\log(0.23) = n \log(0.5)$ $n = \log(0.23) / \log(0.5) = 2.12$ $t = 2.12 \times 5730 = 1.2 \times 10^4$ y	**3x1**
(b) ii	<u>Reason for inaccuracy</u> • Idea that it is impossible to know the exact proportion of ^{14}C in the atmosphere when the bones were formed OR reference to the difficulty of measuring such small percentages of ^{14}C.	**1x1**
(b) iii	<u>Why ^{210}Pb is more suitable:</u> • Idea that the half life of ^{210}Pb is closer to the age of recent bones [e.g. a greater proportion of ^{210}Pb will have decayed as the time elapsed is one or more half lives]	**1x1**
		6

Question Number	Answer	Mark
5(a)	Physics of phenomenon • Hard stone walls reflect (a large fraction of) the incident sound wave • Reflected waves will be in phase if they have a path difference equal to a whole number of wavelengths OR reflected waves will be in antiphase if they have a path difference equal to an odd number of half wavelengths • Reflected waves meeting in phase undergo constructive interference • Constructive interference produces a louder sound • Reflected waves meeting in antiphase undergo destructive interference • Destructive interference produces a quieter sound • Reference to concave shape of walls behaving like a curved mirror and focusing the sound • Pillars may cause a shadow or diffraction effects	**Max 5**
	To reduce the effect • Need a good absorber to reduce reflections • Porous materials (e.g. fibres surrounded by air) make good absorbers • In absorbers the material deforms plastically • Plastic deformation reduces the amplitude of oscillation OR plastic deformation absorbs energy from the wave • Use of reflectors angled in different directions to scatter sound	**Max 3**
		Max 7
	Total for paper	**40**